

## **DEEP SPACE 4 / CHAMPOLLION: A COMET LANDER AND SAMPLE RETURN TECHNOLOGY DEMONSTRATION MISSION**

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The Deep Space 4 / Champollion Mission will accomplish the first landing of scientific instruments on the surface of a cometary nucleus, and will demonstrate technologies for collecting and returning extra-terrestrial samples to a carrier spacecraft, and to Earth. The mission is being developed in collaboration with the New Millennium Program (NMP) at JPL. The goals of NMP are to qualify advanced technologies for use on NASA missions and to perform meaningful scientific measurements with these new technology spacecraft. The DS4/Champollion mission will demonstrate the feasibility of precision guidance and landing, remote sample collection, automated orbital rendezvous and transfer, and other advanced technologies, which could then be used on future sample return missions such as from Mars or from an outer solar system satellite.

The DS4/Champollion mission will launch in April, 2003 on a Delta 7925 launch vehicle, using a 12 kW solar-electric-powered carrier spacecraft to take DS4 to a rendezvous with periodic Comet Tempel 1. Flight time with the SEP stage is 2.7 years, considerably shorter than typical ballistic trajectories. Rendezvous occurs post-perihelion at 2.5 AU from the Sun. After a series of slow flybys, the spacecraft will be placed in a low orbit around the nucleus of P/Tempel 1. DS4/Champollion will spend 5 months at the comet in order to map completely the nucleus surface at high resolution, prior to deploying the Lander spacecraft. In addition, radio tracking data will be used to determine the nucleus mass and gravity harmonics, and will be combined with imaging data to estimate the bulk density of the cometary nucleus.

The 3-axis stabilized Champollion Lander will descend to the comet's surface using autonomous navigation, nulling out the lander velocity just before contact with the nucleus. At touchdown an explosive, deployable harpoon will anchor the spacecraft to the surface to permit drilling operations and other relevant scientific measurements. Operations on the nucleus surface will last 3 - 4 days. The current Champollion payload includes panoramic and near-field cameras, a combined infrared spectrometer/microscope for examining collected samples, a one-meter drill for obtaining cometary samples at depth, a gas chromatograph/mass spectrometer for analyzing collected surface and sub-surface samples, and a physical properties experiment to measure the strength, density, temperature, conductivity and other properties of the nucleus surface. The payload will also likely include a gamma ray spectrometer for elemental analysis of the near-surface materials, and additional new technology instruments.

The Champollion lander will then collect a 100 cc sub-surface sample, detach itself from the anchor, and take off, leaving the lower portion of the spacecraft and most scientific instruments on the comet. The Lander will rendezvous with the Cruise Stage and transfer the sample to the Re-entry Vehicle. The sample will be returned to Earth in May, 2010 for analysis in terrestrial laboratories. The passively cooled, hermetically sealed sample will be enclosed in a direct return capsule that will decelerate in the Earth's atmosphere and then parachute safely to the surface.